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OHIO DEPARTMENT OF HEALTH. *Division of*
" Adult Hygiene"
 R.H. MARKWITH, M.D.
 Director of Health
 Columbus, Ohio
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-- MERCURY AND ITS COMPOUNDS

Mercury was used for industrial purposes in Egypt in 1600 B.C., in Greece 400 B.C., in Rome 100 B.C., and in the Roman Empire 100 A.D. In 430 B.C., Hippocrates wrote a short description of mercury poisoning in workmen. Pliny, the younger, in writing of the disease of slaves mentioned mercurialism along with plumbism and the consumption of potters and grinders.

Early in the sixteenth century, Andrea Mattioli wrote a description of chronic mercurialism in the workers of the Idria mercury deposits of Austria. In 1690, Ramazzini discussed industrial mercury poisoning and in 1761 Giovanni Scopoli wrote a description of mercurial tremor in Idria workers.

Mercury has been mined in Spain since Roman times and Spain today ranks first in the production of mercury. Italy ranks second in the production of mercury and the United States now holds third place in the World's production of quick silver, the greater part of the metal coming from California and Texas. The mercury mines of California are not deep, a few running down about 500 feet below the outcrops. Ninety-five per cent of the output is from cinnabar, HgS , which carries little if any mercurial hazard in mining. Quick silver is also found in droplets where the men say "the silver runs free". These deposits were worked during the World War because of the great demand for quick silver to make mercury fulminate for percussion caps which is its largest use. The mouths and lips of workers after two weeks became swollen and inflamed and their teeth so sore that solid food could not be chewed. One doctor reported that the men not only became poisoned themselves, but they carried home so much mercury in their clothes that their wives became salivated while washing their clothes.

GENERAL INFORMATION

CHEMICAL FORMULA AND SYNONYMS:

(Mercury) Hg , hydrargyrum, quicksilver.

(Mercury fulminate) $\text{Hg}(\text{CNO})_2$, fulminate of mercury.

(Copper amalgam)

(Mercury bichloride) Mercuric chloride, corrosive sublimate.

PROPERTIES:

(Mercury) A silvery, liquid, metallic element, sometimes found native; poisonous! Sp. gr. 13.5953; m.p. -38.85°C .; b.p. 357.33°C . Soluble in nitric acid, insoluble in water, alcohol and ether; wt. per liter of vapor, 8.34 gr.

(Mercury fulminate) Dark brown, crystalline powder; explodes when dry under the slightest friction or shock; must be kept moist until used. Sp. gr. 4.42; m.p.: explodes. Soluble in alcohol, ammonium hydroxide and hot water; slightly soluble in cold water.

(Copper amalgam) A solution of copper in mercury of variable composition.

(Mercury bichloride) White rhombic crystals; sp. gr. 5.44; m.p. 277°C.; b.p. 304°C.; soluble in water, alcohol and ether.

OCCURRENCE:

(Mercury) Found in United States (California), China, Czechoslovakia, Italy, Japan, Mexico, New Zealand, Russia, Spain.

PREPARATION:

(Mercury) By heating cinnabar in air, or with lime.

(Mercury fulminate) By acting on mercury with strong nitric acid and alcohol.

(Copper amalgam) Direct union of copper and mercury.

(Mercury bichloride) (a) By heating mercury in chlorine gas (b) heating a mixture of common salt and mercuric sulfate with a small amount of manganese dioxide added as an oxidizing agent to prevent the formation of calomel (Hg_2Cl_2).

IMPORTANT COMPOUNDS:

(Mercury) Mercuric acetate, mercuric-ammonium chloride, mercuric benzoate, mercuric bromide, mercuric chloride, mercuric cyanide, mercuric iodide, mercuric nitrate, mercuric oleate, mercuric oxide, red; mercuric oxide, yellow; mercuric-potassium cyanide, mercuric-potassium iodide, mercuric salicylate, mercuric sulfate, mercuric sulfide, black; mercuric sulfide, red; mercuric sulfocyanate, mercurous sulfate, mercury fulminate.

USES:

(Mercury) Mercury salts; thermometers; medicine; mirror manufacture; mercury vapor lamps; amalgams; extraction of gold and silver from their ores; physical and chemical apparatus; catalyst; production of fulminate, and vermillion; electric rectifiers; pharmacy; cathode in electrolytic chemical processes; felt manufacture; boiler compounds; cosmetics.

(Mercury fulminate) Manufacture of caps and detonators for producing explosions for military, industrial and sporting purposes.

(Copper amalgam) Formerly used as dental fillings; used in manufacture of brushes for electric generators and motors.

(Mercury bichloride) Medicine; antiseptic; preservative for skins, furs and wood.

INDUSTRIAL HEALTH ASPECTS

MODES OF ENTRANCE: (Mercury and it's compounds) Inhalation, ingestion, and absorption through the skin and subcutaneous tissues. The chief mode of entrance of mercury vapor and dust is by inhalation, of the liquid compounds and solutions of mercury by ingestion, and absorption through the skin or possible inhalation of vapors.

SYMPTOMS OF INDUSTRIAL POISONING: (Mercury) Industrial mercury poisoning is characterized by three cardinal features, one or more of which may be present simultaneously; inflammation of the mouth (stomatitis), psychic irritability (erethism), and muscular tremors ("Hatters shakes"). Inflammation of the mouth and psychic irritability are stated to be more evident in the acute cases in which mercury is absorbed over a short period; tremor may occur more frequently in chronic cases in which absorption has occurred slowly over a long period of time. Symptoms may include metallic taste, sensation of abnormal dryness of mouth and throat, stomatitis, inflammation and softness of the gums, loosening of the teeth, salivation, pain on chewing, blue line on gums, and foetid breath. Psychic changes are usually present such as a nervous timidity, irritability, discouragement, depression, ease of embarrassment, blushing, desire for solitude, vague fears, as of ridicule or criticism, fits of unreasonableness, impatience, inability to take orders, apathy, lack of interest, loss of memory and self-confidence, despondency, and even suicidal tendencies. There is an intentional tremor which is vibratory, intermittent, in small equal strokes and rythmical, worse with efforts to control it, on unusual movements or when movements are observed; it disappears in sleep. The tremor attacks first the eyelids, tongue, fingers, then the voluntary muscles and is usually symmetrical. The central nervous system manifestations of mercurialism are due, in the opinion of some authorities, to a diffuse encephalopathy with predominance of symptoms referable to the cerebral centers most affected.

In the more severe cases there may be found headache, vertigo, and anorexia, nausea or vomiting, diarrhea which may alternate with obstinate constipation, abdominal cramps or distension, weakness and exhaustion, and pain in the muscles, bones and joints. Usually in industrial mercurialism gastro-intestinal symptoms are not prominent, and there is not much if any involvement of the kidneys, apparently they can eliminate mercury for a long period without damage, and urinary changes may be slight or absent in the slow chronic form of poisoning. An increased incidence of albumin in the urine has been reported; lymphocytosis of slight degree is also stated to occur.

Inflammation may occur at the points of excretion of mercury, thus nephritis, colitis, gastric and duodenal ulcer have been reported as a sequelae of severe poisoning. Also inflammation may occur at the openings of salivary ducts or other points of excretion. It is believed that mercury ingested or absorbed as dust would form in the blood chloro-albuminate or oxychloro-albuminate while mercury inhaled as vapor would circulate as such in the blood for some time.

Toxic dose of mercury vapor cannot be stated with certainty but Gothlin concludes that 0.4 to 1 mg. of mercury absorbed daily would set up a gradual chronic poisoning after some months. The Norlander mercury vapor detector introduced by the General Electric Co. is a valuable instrument for the estimation of mercury as vapor in the air.

Youth, female sex, alcoholism and infection appear to increase the susceptibility to mercury poisoning.

(Mercury fulminate) Controversy exists whether symptoms of exposed workers are due to this substance or another. Fulminate workers may show various forms of eczema and dermatoses which are particularly important. Also there may be present stomatitis, salivation, blackened brittle or decayed teeth, inflammation of the gums, conjunctivitis, blepharitis, digestive disturbances, diarrhea, menstrual disturbances, headache, insomnia, tremors, cachexia, and depression. Poisoning may result from mercury fumes when the mercury detonates as has occurred in shooting galleries, etc. The symptoms observed are stomatitis, nausea, vomiting and colic.

(Copper amalgam) Symptoms produced by this substance are due to the dust or vapor arising in its use. The symptoms are similar to those produced by mercury, the severity of them depending on the amount of dust or vapor present.

(Mercury bichloride) The increased solubility of mercury bichloride makes it more toxic than free mercury. Poisoning may occur accidentally or with suicidal intention. Symptoms of acute poisoning due to the coagulation, irritation and superficial corrosive action may occur in a few minutes. There may be a burning sensation in the throat, astringent metallic taste, salivation, great thirst, abdominal distress, pain and vomiting in about five minutes. There is a gray ashy discoloration with a white coating forming in the mouth and pharynx, with edema of glottis. Temperature may be febrile or subnormal, cold sweat with weak irregular pulse. Diarrhea may occur within two hours with a liquid and blood stained stools. The urine is scanty or depressed, cells and albumin being present; and anuria may occur with a rise in the non-protein nitrogen of the blood. The salivation, stomatitis, glossitis and gingivitis with severe abdominal pains may persist several days.

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INDUSTRIES AND OCCUPATIONS

INDUSTRIES: Ohio Industries using mercury and its compounds as indicated in the Ohio Industrial Hygiene Survey are listed as follows:

Dairy products	Instruments
Dental supplies	Jewelry
Electrical machinery	Other manufacturing plants
Explosives, ammunitions, fireworks	Rubber tires
Hats and caps	Signs

OCCUPATIONS: Occupations in Ohio where contact with mercury and its compounds was indicated are listed as follows:

Assemblers (instruments)	Letter foremen (electrical machinery)
Assembly line girls (electrical machinery)	Letter out men (electrical machinery)
Assistant technicians (dairy products)	Oven tenders (electrical machinery)
Bakers (electrical machinery)	Packers (electrical machinery)
Bench workers (dental supplies)	Platers (signs)
Blockers (hats and caps)	Pump boys (electrical machinery; other manufacturing plants)
Chief technicians (dairy products)	Pumpers (electrical machinery)
Dental technicians (dental supplies)	Scratchers (instruments)
Explosive makers (explosives, ammunitions, fireworks)	Sealers (instruments)
Foremen (electrical machinery)	Sign makers (signs)
Glass blowers (instruments)	Testers (electrical machinery)
Instrument repairmen (rubber tires)	Thermo-meter fillers (instruments)
Jewelry makers (jewelry)	
Laboratory workers (dental supplies; electrical machinery)	

Occupations which offer contact with mercury and its compounds but not listed in the Ohio Survey are:*

Acetaldehyde makers	Cap loaders
Acetic-acid makers	Carroters (felt hats)
Acetone (synthetic) makers	Cartridge makers
Alcohol (synthetic) makers	Chlorine makers (electrolytic)
Amalgam makers	Color makers
Artificial-flower makers	Coners (felt hats)
Barometer makers	Cosmetic workers
Battery (dry) makers	Cyanogen gas makers
Blowers (felt hats)	Detonator cleaners
Bronzers	Devil operators (felt hats)
Browners (gun barrels)	Disinfectant makers
Brushers (felt hats)	Dye makers
Calico printers	Embalmers

Embossers
Extractors (gold and silver)
Felt-hat makers
Fireworks makers
Fulminate mixers
Fur handlers
Fur preparers
Gilders
Hardeners (felt hats)
Lithographers
Mercury-alloy makers
Mercury bronzers
Mercury miners
Mercury smelters
Mercury-solder workers
Mercury-still cleaners

Mercury-switch makers
Mercury-vapor-lamp makers
Mirror silverers
Mixers (felt hats)
Painters
Photographic workers
Porcelain makers
Refiners (metals)
Sole stitchers
Steel engravers
Storage-battery makers
Tannery workers
Taxidermists
Welders
Wood preservers
Zinc-electrode makers

INDUSTRIAL MERCURIALISM; REPORT OF AN INVESTIGATION

Kistler, J.B.; Fisher, W.G.; Young, C.B.; Smucker, C.A.; and Morrison, A.R. Summarized from informative bulletin "Industrial Mercurialism" published by the Ohio Department of Health, R.H. Markwith, M.D., Director of Health - 1940.

Summary of an investigation of industrial mercurialism among employees of an industry manufacturing an electrical apparatus containing copper amalgam and made by a secret process.

1. An investigation of the facilities, materials, and processes of an industrial establishment engaged in the manufacture of an electrical apparatus revealed the presence of a mercury hazard.

2. Opportunity was afforded for the observation of employees of this plant during and following significant exposures to mercury in the form of vapor and amalgam dust.

3. Exposure to mercury vapor over a period of one year resulted in positive signs and symptoms of mercury poisoning in the workers examined.

4. Sore mouths, fine tremors of fingers and tongue, digestive disturbance, constipation, dysentery, skin eruptions, excessive flow of saliva, loss of weight, nausea and psychic irritability were the symptoms of mercurialism found in this study.

5. Mercury vapor samples taken with the Nordlander apparatus gave concentrations up to 85 milligrams of mercury per 10 cubic meters of air. These concentrations are not surprising since a considerable quantity of the amalgam was heated to 500°F., at which temperature the vaporization of mercury is comparatively rapid.

6. Amalgam dust samples taken with the Greenburg-Smith impinger after elimination of the mercury vapor exposure indicated that amalgam dust by reason of its greater weight settles out rapidly and concentrations rapidly decrease as the distance from the source of production increases. It is doubtful if mercury dust played a very important role in the production of symptoms of mercurialism among the employees.

7. Institution of control measures resulted in the practical disappearance of symptoms of mercurialism among employees observed and the virtual disappearance of detectable quantities of mercury fumes and dust from the general atmosphere of the factory.

8. Excretion of mercury in the urine was followed for a period of eight months after the mercury vapor exposure was terminated. The amount of mercury in the urine ranged from 1.11 to 0.01 milligrams per liter and the rate of mercury excretion was found to be a function of the log of the time elapsed after the termination of the exposure.

SELECTED ABSTRACTS

MERCURY POISONING FROM THE PUBLIC HEALTH VIEWPOINT.

P.A. Neal. Am. J. Pub. Health, vol. 28, pp. 907-915 (Aug. 1938).

Abstracted in J. of Ind. Hygiene, vol. 20, no. 9, pp. 195-196 (abstract section) Nov. 1938.

In this paper Doctor Neal first discusses the history of mercurialism, which like so many other facts of scientific and medical interest goes back at least to Egyptian times. The use of mercury as a drug probably was started in India in the first century A.D. Its increased use in medicine brought attention to the occurrence of mercury poisoning among miners. The paper goes on to discuss the industrial uses of mercury today. A very clear table lists the various industries and occupations with a mercury hazard. It is clear from the table that while the manufacture of felt hats presents one of the largest single problems, the hazard is also present in many other industries. It is also made clear that inhalation of mercury dust or vapor is the chief method of entrance into the body.

The symptomatology of chronic mercurialism is discussed; the two general types, one with stomatitis, colitis, and nephritis, the other with predominately neurological symptoms, may exist separately or together. The threshold dosage, Doctor Neal states, cannot definitely be given. In the study made by the Public Health Service of the fur cutters' trade, the incidence of mercurialism among those exposed to concentrations of less than 2.0 mgm./cu.m. was found to be 4.5% (377 persons) while those exposed to greater concentrations (152 cases) showed an incidence of 17.1%. The diagnosis of chronic mercurialism is based on the history of exposure, careful physical examination (noting not only pallor, gingivitis, etc., but also neurological and psychic disturbances), and laboratory examination. Quantitative spectrographic analysis of 24 hour urine specimens should be used. There is as yet no adequate quantitative method for determination of mercury in the blood. Routine blood chemistry and cytology is of slight value.

The prevention of chronic mercurialism consists principally of elimination of mercury vapors and dusts. This falls primarily on the shoulders of the engineer. The industrial physician should carry out periodic examinations of workers exposed to a mercury hazard. Those suffering from mild poisoning should be removed from all exposure and kept away until the hazard has been controlled; severe cases require long and careful medical attention.--Thomas L. Shipman.

THE DANGER OF MERCURY VAPOR.

A. Stock. Abstr. from Ztschr. f. angew. Chem., 1926, vol. 39, pp. 461-466, in Zentralbl. f. Gewerbehyg., Aug.-Sept., 1926, N.S. vol. 3, pp. 257-258.

Abstracted in J. of Ind. Hygiene, vol. 9, no. 4, pp. 88-89 (abstract section) April 1927.

Dr. Stock, director of the Kaiser Wilhelm Institute of Chemistry, describes his experiences with mercury vapor and the injurious effects it had on his health. He gives emphatic warning to use great care in working with

this metal.

Stock suffered for about twenty-five years. At first the attacks were light and occurred at intervals, but later they increased gradually until they became almost unbearable. The cause was recognized neither by himself nor by the numerous physicians whom he consulted. Through a fortunate accident it was discovered to be a slow, lingering poisoning from mercury vapor, with which he had been working for twenty-five years. After two years' treatment all manifestations have either entirely disappeared or are greatly diminished. The malady, which was also shared by his colleagues, began with slight headache and numbness, increased in the course of years to a continuous state of nervous unrest, and became a ceaseless torturing pain above the eyes, with dizziness and disturbance of vision. Gradually the air passages were drawn into sympathy, and the nose, mouth, throat, and ear became severely affected. Also the mind became exhausted and the memory, weak.

The remedial means adopted are minutely described; most important are a thorough house cleaning and proper ventilation of his laboratory. Plenty of fresh air is recommended.

Stock mentions other similar cases that he has known and expresses the opinion that Faraday was an unsuspecting victim of mercury poisoning. He also warns against amalgam dental fillings.

The treatise is well worth reading by everybody that works with mercury.
--A.W.N.

THE DETERMINATION OF MERCURY IN CARROTED FUR.

F.H. Goldman. U.S. Pub. Health Repts., vol. 52, pp. 221-223 (Feb. 19, 1937).

Abstracted in J. of Ind. Hygiene, vol. 19, no. 5, pp. 116-117 (abstract section) May 1937.

In preparing fur of rabbits and hares for the manufacture of felt hats, the pelts are treated with a solution made by dissolving mercury in nitric acid ("carroting"). In this process the workers are exposed to fumes and to dust. One hundred and thirty samples of this mercury-impregnated dust were found to average 0.3 mg. mercury. (Two cubic meters of air were drawn through 100 cc. of an alcohol-water mixture.)

Treatment with potassium permanganate and sulfuric acid followed by heating for a short time caused only a slight loss of mercury. Samples were then prepared for electrolyzing, and the mercury was plated out as described by Fraser. Ten samples of factory workroom dust ranged from 0.13 to 0.74 mgm. mercury. The experimental method is described.--Helen Lawson.

A SIMPLIFIED PROCEDURE FOR THE DETERMINATION OF MERCURY IN URINE.

A.O. Gettler and R.A. Lehman. Am. J. Clin. Path., Tech. Supplement, vol. 8, pp. 161-164 (1938).

Abstracted in J. of Ind. Hygiene, vol. 21, no. 1, pp. 25-26 (abstract section) Jan. 1939.

A 50 cc. portion of the urine is ashed in a 500 cc. Kjeldahl by means of potassium permanganate and sulfuric acid. The mercury is separated by means of diphenylthiocarbazone and the intensity of color compared with that of known standards. The ordinary chemically pure reagents were found to be satisfactory and the blanks were negligible. The time required for a series of five determinations is about 3 hours. The simplified procedure is more rapid than the Winkler method and equally accurate.--L.T. Fairhall.

THE QUESTION OF THE BODY CONTENT OF MERCURY.

Holtzmann. Arch. f. Hyg., Sept., 1931, vol. 106, pp. 377-380.

Abstracted in J. of Ind. Hygiene, vol. 14, no. 6, p. 139 (abstract section) June 1932.

Guinea-pigs were exposed to air saturated with mercury vapor and containing 6 mg. of mercury per cubic meter of air. Lungs and kidneys and the remaining portion of the animals were analyzed for mercury. In a few animals the lungs, liver, kidneys, urine, heart, brain, stomach, intestine, gall-bladder, and remaining tissues were analyzed. Traces of mercury varying from 2.5µg. to 1,050µg. were found in the various tissues, depending upon the time of exposure and the promptness with which the animal was killed following exposure.--L.T.F.

DISTRIBUTION OF MERCURY AFTER ITS INHALATION.

W. Wirth. Arch. f. exp. Pathol. u. Pharmakol., vol. 184, pp. 91-92 (1936).

Abstracted in J. of Ind. Hygiene, vol. 19, no. 4, p. 90 (abstract section) April 1937.

Experiments on dogs showed that the lungs quickly take up large quantities of mercury and give it off again relatively soon. The kidneys and liver store it for longer periods. The amount in the brain was also increased.--L. Teleky.

HEALTH INJURIES FROM ORGANIC MERCURY COMPOUNDS.

F. Koelsch. Arch. f. Gewerbepathol. u. Gewerbehyg., vol. 8, pp. 113-116 (1937).

Abstracted in J. of Ind. Hygiene, vol. 20, no. 2, p. 46 (abstract section) Feb. 1938.

In recent years mercury compounds have found increasing use as seed disinfectants (such as Ceresan, Germisan, Tillatin R, and others). The author has observed patients employed in both the production and use of these substances. There is a local irritation of body surface, skin and mucosa, swelling of the face and also on the rest of the body, skin itching, and swallowing and speech disturbances. General symptoms with special effect on the nervous system: bad headaches, fatigue, uncertainty on the feet, decreased visual ability. Only after several months did any improvement set in. It is suggested that infectious foci in the tonsils favored the development of acute nephritis in one case.--L. Teleky.

EXPERIMENTAL STUDIES ON ACUTE MERCURIAL POISONING.

S.M. Rosenthal. U.S. Pub. Health Repts., Dec. 29, 1933, vol. 48, pp. 1543-1560.

Abstracted in J. of Ind. Hygiene, vol. 16, no. 2, p. 28 (abstract section) Mar. 1934.

The rate of oxygen consumption of excised rat tissue was used as an index of protective power of various substances against the toxic effect of mercuric chloride. Of the three substances studied in particular (sodium thiosulfate, glutathione, and formaldehyde sulfoxalate) the last gave the best results. In the case of dogs nine out of twelve recovered while nine out of ten of the controls died. One human case treated with formaldehyde sulfoxalate recovered without any kidney damage occurring.--L.T. Fairhall.

ACTION OF VERY MINUTE DOSES OF MERCURY ON THE DIFFERENTIAL BLOOD PICTURE.

K. Luddicke. Abstr. as follows from Klin. Wchnschr., 1928, vol. 7, pp. 398-401, in Chem. Abstr., July 20, 1928, vol. 22, p. 2618.

Abstracted in J. of Ind. Hygiene, vol. 11, no. 4, p. 87 (abstract section) April 1929.

Mercury, in very minute quantities, is absorbed from copper amalgam fillings or from the atmosphere in rooms containing reservoirs of mercury (either as liquid metal or as mercury ointment). The urine of persons exposed in this manner contains demonstrable amounts of mercury. The metal, even in these small concentrations, is poisonous. The objective symptoms are stomatitis, salivation, colitis, and tremor. Persons whose urine contains demonstrable amounts of mercury always show an increased concentration of lymphocytes in the differential count.

MERCURIAL ENCEPHALOPATHY: ITS COURSE AND PROGNOSIS: THIRTEEN CASES.

A.J. Kulkov. Abstr. as follows from Kazansky med. jur., March, 1931, vol. 27, p. 262, in Jour. Am. Med. Assn., July 25, 1931, vol. 97, p. 291.

Abstracted in J. of Ind. Hygiene, vol. 14, no. 2, p. 35 (abstract section) Feb. 1932.

Kulkov observed thirteen cases of mercurial poisoning and reaches the following conclusions: (1) The differences in the course of mercurial encephalopathy in adults and in children are mostly due to the great severity with which mercury affects the child. This is why the subsequent picture of the illness is much more grave in children. Evidently, the destructive processes which have been provoked by the poison progress so far that there develops a definite limit to real improvement. In a large part this phenomenon is connected with the general mental inferiority of the child and the defects in his speech. Mutism, indeed, in most of the patients disappears, but the speech always remains remarkably defective. Thus, the course of the disease as well as the prognosis is rather unfavorable. (2) The course of the disease in adults is satisfactory as long as the patient quits his work with mercury. But even in such cases a great deal depends on the person affected. In one case observed, the patient worked with mercury for only two days and got sick, while the rest of the workers became ill in a period of months. The patient's return to work with mercury will not necessarily lead to a recidivation. (3) The laboratory investigations bring out

that the gravity of symptoms in mercurial encephalopathy is, evidently, due to the storage of mercury in the system. When elimination of mercury begins, the clinical picture shows rapid improvement.--C.K.D.

FUNCTIONAL DISTURBANCE OF THYROID IN MERCURIAL POISONING.

M.A. Kazakevich. *Klinicheskaya Meditsina*, (Moscow), 1933, vol. 11, p. 1247.

Abstracted in *J. of Ind. Hygiene*, vol. 16, no. 4, p. 80 (abstract section) July 1934.

Kazakevich investigated 133 workers in a mercury plant. Of these, 48 were men and 85 women; 60.9 per cent of the group were between 20 and 30 years of age. The duration of occupation was from 6 months to 3 years. Manifestations of a thyrogenous character with an enlargement of the thyroid were observed in 57.3 per cent. The incidence of vasomotor neurotic states of thyrogenous character raises the percentage to 88.9. The following constituted characteristic complaints: irritability, somnolence, poor memory, disturbed sleep, headache, tremor of the extremities, particularly of the fingers, flushes, sweating, palpitations, falling out of the hair, increased salivation, bleeding gums, weakness and apathy. Among the characteristic objective signs were tremor of the eyelids, dilated pupils, exophthalmos, absent or weakened pharyngeal and conjunctival reflexes, tremor of the fingers, red dermographism, increased sweating and salivation, enlarged and tender thyroid, and falling out of hair. Double color line of the gums, pale skin and mucous membranes, arterial hypotonus and labile pulse were rather frequent signs in chronic mercurial poisoning. Enlargement of the cervical and inguinal lymph nodes was present in almost all cases. In the beginning the nervous system reacts to mercurial intoxication with a vasomotor neurosis, which gradually develops into hyperthyroidism if the intoxication continues. The highest values of mercury excreted in the urine were found in adolescents up to the age of 20 and disturbances of the thyroid function and of the vegetative nervous system occurred in them with greatest frequency. The incidence of hyperthyroidism was higher in women than in men. The author urges a number of preventive measures for the removal of mercurial vapors, exclusion of workers below the age of 20, and the consideration of limiting in some cases the period of employment to 6 months at one time. Administration of salts of iodine and of bromine because of the readiness with which these halogens combine with mercury is recommended just as soon as the first signs of mercurial irritation appear.

RELATION BETWEEN LOCAL AND GENERAL INJURIES IN INDUSTRIAL INTOXICATIONS (ON THE BASIS OF A CASE OF MERCURY POISONING).

A. Vannotti. *Arch. f. Gewerbepath. u. Gewerbehyg.*, vol. 8, pp. 266-276 (1937).

Abstracted in *J. of Ind. Hygiene*, vol. 20, no. 4, pp. 82-83 (abstract section) April 1938.

The author reports on an attendant who had to prepare great quantities of gray ointment (Hg) and white precipitate ointment (NH_2HgCl). He fell ill with pains and paresthesias in various nerve areas and showed albuminuria and granulated cylinders. After some time the patient returned to his work and again fell ill with high grade edema and severe symptoms of kidney and

liver injury. He did not present typical symptoms of an acute or chronic Hg poisoning. The author interprets the disease as Hg poisoning (?-L.T.) and discusses it carefully from all angles.--L. Teleky.

TREATMENT OF ACUTE POISONING FROM MERCURY SALTS BY MEANS OF HYDROGEN SULPHIDE (STRYZOWSKI ANTIDOTE).

L. Mischaud. Schweiz. med. Wchnschr., vol. 67, pp. 818-820 (1937).

Abstracted in J. of Ind. Hygiene, vol. 20, no. 1, p. 11 (abstract section) Jan. 1938.

The author reports a case of sublimate poisoning (1.5 gr.). Two hours after the poison was taken, 50 cc. of the antidote was given, after vomiting and washing out the stomach; a few hours later another 50 cc. was administered. Improvement followed a few days later. A severe nephritis appeared but this was quickly cured which the author considers due to other treatment-ingestion of alkalies, intravenous dosage of glucose and diathermy.--L. Teleky.

MERCURY POISONING IN MINING.

J.A.M.A. (queries and minor notes), vol. III, p. 467 (1938).

Abstracted in J. of Ind. Hygiene, vol. 21, no. 1, pp. 15-16 (abstract section) Jan. 1939.

The inquiry concerns the possibility of being acutely poisoned by mercury vapor in one day's work in a gold mine, and the determination of mercury or lead poisoning several months later.

With high concentrations, mercury poisoning can take place in a few hours. Stomatitis is the chief symptom in acute poisoning from the compounds. In poisoning from the vapor, the chief symptoms are tremor and central nervous system signs. Diarrhea, nausea, etc. may be seen. Some of the muscular and nervous symptoms may persist. Mercury does not always appear in the urine of poisoned persons. Methods for determination of mercury in urine and in air are referred to. Hard rock mining seldom offers a mercury hazard.--Helen Lawson.

ALTERATIONS IN THE NERVOUS SYSTEM IN WORKERS IN QUICKSILVER MINES.

A.M. Weger. Abstr. as follows from Arch. f. Gewerbepath. u. Gewerbehyg., 1930, vol. 1, pp. 522-538, in Bull. Hyg., June, 1931, vol. 6, pp. 470-471.

Abstracted in J. of Ind. Hygiene, vol. 13, no. 9, pp. 235-236 (abstract section) Nov. 1931.

A brief account only is needed of this paper, seeing that it is recognized how few engaged in the recovery of mercury escape the effects from the vapor.

The author examined 138 workmen engaged in recovering mercury in the mines of Nikitowka (in the Don valley); of these, only twenty-nine were free from obvious changes in the nervous system, while 109 (79 per cent) were obviously affected. These changes take the form of tremor, hypochondriacal fears and neurasthenia, psychical depression (mercurial erythism). Lesions of the nervous system from mercurial intoxication showed themselves on the

average after three months' employment.

Improvement in health, in the author's opinion, can be found only by (a) mechanization of all the industrial processes, (b) prohibition of the employment of women and young persons, and (c) regular periodic medical examination of the workmen. A detailed protocol is given of the symptoms in five cases.--T.M.L.

A STUDY OF CHRONIC MERCURIALISM IN THE HATTERS' FUR-CUTTING INDUSTRY.

P.A. Neal, R.R. Jones, J.J. Bloomfield, J.M. DallaValle and T.I. Edwards.
U.S. Pub. Health Bull. no. 234 (May, 1937).

Abstracted in J. of Ind. Hygiene, vol. 20, no. 1, pp. 10-11 (abstract section) Jan. 1938.

This study was carried on from February to May 1935 covering all the fur cutting factories then operating (36 in number) and physical examinations were made of 529 men and women (including x-rays and laboratory tests of urine and blood) who make up 26.4% of the fur cutters in the United States. Estimations of Hg. vapor in the air and dust counts were made in 5 factories. The processes of fur cutting are described in detail and abundantly illustrated. The plants were found to be larger than in the average industry but the provision of medical care was more limited.

Hg. in vapor and dust varied from a trace to a maximum of 10.4 mgm./10 cu.m. of air. The workers most exposed are shippers, next pilers, then blowers, cutters and sorters, the last being the largest single group and composed entirely of women. Contrary to the usual belief, carroters who apply the mercuric nitrate to the pelts, are not exposed at all to Hg vapors. The amount of dust in the air is not high enough to be inimical to health.

Medical examination covered 298 men and 231 women, the average age of the former being 39 years, of the latter, 34 years. Of the men, 56% had worked less than 10 years, of the women, 78.4%. Forty-three were found to be suffering from chronic mercurialism, 486 were not so affected, although "it is probable that a number of subclinical cases of chronic mercurialism are included in the group." Examination of the 43 cases showed clearly that symptoms of psychotic and neurotic character and of digestive disturbance increase with the increasing amount of mercury in the air. Thus, of the 107 workers exposed to less than 1.0 mgm./10 cu.m., only 4, (3.7%) had mental symptoms, while of the 144 exposed to more than 2.5 mgm., 25 (17.4%) had such symptoms. The results of the medical examination are well summarized in tables in which an interesting comparison is made between the fur cutters and other industrial workers with regard to various forms of ill health. This was possible because of the data already collected in other industries by the Public Health Service. Thus it is seen that psychic disturbances and fine intention tremor were present in 34 out of 43 cutters, while the incidence to be expected would be only 3.2.

The picture of chronic mercurialism corresponds to the classical one in all important features and the lack of severe stomatitis is also typical of the slow form found in hatters. Salivation, also usually slight in this industry, was found in only 10, all of whom worked in air containing more than 2.5 mgm./10 cu.m. of air.

As for other diseases, the incidence of urinary diseases is not high, of pneumonia and of syphilis, rather low.

Practical suggestions are made for the protection of the health of the cutters, by use of local exhausts and by segregating those occupations which do not involve exposure to Hg. This last measure would remove from poisoned air no less than 21.3% of all employed, who now, though handling uncarroted fur, breathe air containing from 0.7 to 2.3 mgm./10 cu.m.--Alice Hamilton.

OBSERVATIONS AND EXPERIMENTS ON MERCURY POISONING IN THE LABORATORY.

E.H. Christensen, M. Krogh, and M. Nielsen. Skand. Arch. f. Physiol., vol. 76, pp. 273-278 (1937).

Abstracted in J. of Ind. Hygiene, vol. 19, no. 10, pp. 220-221 (abstract section) Dec. 1937.

In order to study the effect of increased carbon dioxide content on inspired air, three persons exposed themselves for 10 hrs. in a low pressure chamber of 27 cu.m. At the end they had to stop the experiment as their general condition became worse and they coughed a great deal. The next day they still felt sick and two of them developed stomatitis. This experiment differed from previous ones (in which no harm resulted) in that a few mercury receptacles were in the chamber and from these many mercury droplets had fallen to the table and floor. By careful experiments, the cause of the trouble was traced back to the mercury. Conditions favored the effect of the small amounts of mercury--the carbon dioxide (which increased lung ventilation), thorough mixture of the air by ventilators, and high temperature. As all of this took place in a closed system, the small amounts of mercury were important.

In experimental animals (guinea-pigs), definite lung changes were seen after exposure to high concentrations; in animals that lived 2 or 3 days, no definite lung symptoms were present, but there was hyperemia and ulcerations in the colon and cecum; in those living still longer, definite hyperemia in the cecum. This experience calls attention to the care needed in such experiments.--L. Teleky.

CHRONIC MERCURY POISONING AMONG ATTENDANTS AT SHOOTING GALLERIES.

R. Garcin, J. Christophe, A. Bocage, and L. Helion. Bull. et mem. Soc. med. d. hop., March 9, 1931, vol. 47, pp. 335-341.

Abstracted in J. of Ind. Hygiene, vol. 13, no. 8, p. 202 (abstract section) Oct. 1931.

Details are given of three cases of mercury poisoning, with a full discussion of the symptoms observed among attendants at shooting galleries. The poisoning arises from fulminate of mercury used for charging the caps of cartridges. On a fete day 3,000 to 4,000 cartridges may be fired off in a confined space insufficiently ventilated, especially when tubes are used with targets at the far end. Dust containing mercury is plentiful in the booths and any rings worn become amalgamed. Apparently absorption occurs by inhalation. The symptoms experienced include muscular trembling and incoordination with scanning and explosive speech, diarrhea, and gingivitis with dark line on the gums, rhinitis, and conjunctivitis. This type of sickness is well recognized among the attendants themselves, although it has not previously been reported in the medical press.--E.L.C.

MERCURY POISONING FROM ELECTRIC FURNACES.

L. Jordan and W.P. Barrows. Jour. Indust. and Engin. Chem., Sept., 1924, vol. 16, pp. 898-901.

Abstracted in J. of Ind. Hygiene, vol. 7, no. 5, pp. 78-79 (abstract section) May 1925.

Four cases of subacute or chronic mercurial poisoning were found among men operating high-frequency induction furnaces. One case terminated fatally; two of the other three cases were quite serious.

A survey of laboratory conditions during operation of the furnaces indicated the escape of mercury vapor from the mercury discharge gaps of the high-frequency converters. The concentration of mercury vapor in the air beside the furnace during operation was as high as 0.7 mg. per cubic meter, a concentration sufficient to cause mercury poisoning if daily exposure continued for several months or longer. Another source of possible poisoning existed in the frequent cleaning of the mercury and repairs necessary in the original type of discharge gap.

A new type of discharge gap having stationary electrodes, mercury-sealed discharge chambers, and operating in an atmosphere of hydrogen, was installed and enclosed in a separate compartment fitted with a forced-draft hood. Under these conditions the escape of mercury from the discharge gap could not be detected. Repairs to the gap are infrequent and the necessity of cleaning the mercury is practically eliminated in the present equipment.

The amount of mercury in the air of the laboratory was determined (a) by drawing the air through a glass tube packed with gold leaf and determining the increase in weight, and (b) by bubbling the air through a Palmer apparatus containing aqua regia and analyzing for mercury by the reverse of the Nessler reaction for ammonia. That is, a solution containing ammonium chloride, potassium hydroxide, and potassium iodide was added to the solution containing mercuric chloride in unknown concentrations. The brown color produced was then matched against the color produced by known amounts of mercuric chloride. This procedure was found to be the more satisfactory of the two methods.--P.D.

ACUTE POISONING FROM MERCURY VAPOR.

A. Hopmann. Abstr. as follows from Zentralbl. f. Gewerbehyg., Dec., 1927, N.S. vol. 4, pp. 422-423, in Bull. Hyg., July, 1928, vol. 3, p. 585.

Abstracted in J. of Ind. Hygiene, vol. 11, no. 4, pp. 86-87 (abstract section) April 1929.

The author describes two occurrences in industry of acute mercury poisoning in each case affecting two men. He emphasizes the risk run in repair work inside boilers where the rust or residues contain this metal. Heat introduced into the boiler causes rapid vaporization of the concealed mercury, and blows on the sides may detach dust.

Two plumbers were inserting rivets inside a boiler in which, several years before, mercury had been treated. After three and one-half hours' work both men became unwell with "sensations as of drunkenness," inflamma-

tion of the mucous membrane of the respiratory tract showing itself in cough and bronchitis. Both were incapacitated from work for fourteen days. Examination of the rust on the inside of the walls of the boiler showed the presence of mercury. Examination of the urine (not made until some days after the first attack) showed 0.2 and 0.19 mg. of mercury per liter.

The same boiler was later cut up by the oxyacetylene blowpipe in the open air and the man who did it suffered from severe headache. His urine (passed fourteen days after) showed 0.06 mg. of mercury per liter.

Two other plumbers were employed in a cramped position inside a boiler of 13 cu.m. capacity. After four and one-half hours one of them vomited and a little later the other complained of sickness and trembling. The subsequent symptoms of the second plumber in hospital were great excitement and tremor, headache, pain in the chest, and cough. Fine rales were heard all over the lungs. The rectal temperature reached 104°F. He returned to work in eleven days. The lung symptoms rapidly disappeared-headache and weakness remained for several days. The urine passed on the second day showed 0.23 mg. of mercury per liter.

The symptoms in the plumber first to feel the effects were very similar but not so severe. His urine contained 0.27 mg. per liter.

The mercury content inside the boiler was found after illness showed itself to contain 4.98 mg. per cubic meter.

The author lays stress on the importance of careful prophylactic measures in repairs of vessels that have contained mercury-thorough cleaning, exhaust ventilation, blowing in of fresh air, and suitable breathing apparatus.

PROTECTION AGAINST MERCURY VAPOR AFFORDED BY CANISTER GAS MASKS.

W.P. Yant, and C.E. Traubert. U.S. Bur. Mines, Rep. Investigations, Serial No. 3187, October, 1932, pp. 12, (mimeographed).

Abstracted in J. of Ind. Hygiene, vol. 15, no. 2, p. 13 (abstract section) March 1933.

"Two charcoal-filled gas-mask canisters, three type-N gas-mask canisters, and two charcoal-filled respirator cartridges, all of which were commercial products, were tested for efficiency of protection against mercury vapor. The test procedure is described and the detailed results presented, including the preparation and sensitivity of selenium sulphide test papers for mercury vapor. The conditions of the tests were air-saturated with mercury vapor at 63°C. or 145°F. at a rate of air flow of 32 liters per minute. The concentration of mercury under these conditions was 42.5 p.p.m. by volume."

"The charcoal-filled canisters had a life of 112 and 117 minutes, respectively. The three type-N canisters had a life of 14 hours 50 minutes, 23 hours 40 minutes, and 35 hours 30 minutes, respectively. Owing to the long life period of the type-N canisters they were not tested continuously to the end of life, but had intervening rest periods. The life period in-

creased with rest time between the test periods, and shows that considerable recuperation would take place in practical usage. The longer life period of the type-N canister, which contains less charcoal than the charcoal-filled canister, indicates that at least one other absorbent in this canister is more effective than charcoal alone for removing mercury vapor from air."

"The charcoal-filled respirator cartridges had a life of only 2 minutes when tested under the conditions of air saturated at 63°C. with mercury vapor. Two additional respirator cartridges were tested against air saturated at 25°C. with mercury vapor and a rate of 32 liters a minute. Under these conditions their lives were 10 and 9 minutes, respectively."

"Air saturated with mercury vapor at 63°C. exceeds in severity any atmospheres met in practise, and accordingly the period of practical service given by both the charcoal-filled and type-N canisters would be many times the period found in these tests. However, the period of service given by the charcoal-filled respirator cartridges is too short to be of practical value."

"It is pointed out that respirators of the filter type are also inadequate for protection against mercury vapor, and in fact might even increase exposure after the filtering medium had become contaminated with mercury. A filter to stop mercury mist or particles of mercury compounds is recommended for use in conjunction with an absorbent, but the filter should be placed upstream to the flow of gas so that any vapor given off by mercury caught in the filter may be subsequently absorbed."

"The face pieces and breathing tubes of all gas masks used for protection against mercury vapor should be thoroughly cleaned after each period of usage and placed where there is no danger that mercury will deposit on the surfaces. Very small amounts of mercury distributed over the surface of these parts will contaminate the air breathed, even though the canister removes the mercury vapor from the incoming air."

"The freedom from mercury vapor in the air breathed and the end of the life period of canisters may be ascertained by placing a small piece of selenium sulphide test paper in the face piece or suspending it in the breathing tube. The presence of mercury vapor or leakage of mercury vapor during use will be indicated by a blackening of the paper."

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